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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

SAVLA, ARPAN P

ART UNIT

PAPER NUMBER

2185

NOTIFICATION DATE

DELIVERY MODE

08/12/2009

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/824,751	Applicant(s) DUSSUD, PATRICK H.	
	Examiner Arpan P. Savla	Art Unit 2185	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 June 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12, 14 and 17-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12, 14 and 17-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 June 2009 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

This Office action is in response to Applicant's communication filed June 8, 2009 in response to the Office action dated December 9, 2008. Claims 1, 2, 5, 6, 11, 12, 14, 17, and 19 have been amended. Claims 1-12, 14, and 17-24 are pending in this application.

REJECTIONS BASED ON PRIOR ART

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. **Claims 1-12, 14, and 17-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dussud (U.S. Patent 6,502,111) in view of Applicant's admitted prior art (hereinafter "AAPA").**

3. **As per claim 1**, Dussud discloses a computer-readable storage medium apparatus having computer-executable instructions for performing ephemeral garbage collection, the computer readable storage medium being accessible by a computing device (col. 14, lines 26-35), the instructions when executed, configuring the computer device to perform operations comprising:

requesting a list from a tracking mechanism (col. 5, lines 50-51; Fig. 1, element 32), the list identifying a plurality of memory locations that have been accessed since a last ephemeral garbage collection process (col. 5, lines 42-45; col. 6, lines 34-44), each memory location corresponding to one of a plurality of cards associated with one or more objects allocated from with a memory heap, each of the plurality of cards associated with a card table, wherein the card table identifies one or more of the plurality of cards with one or more objects that have been accessed (col. 5, line 64 – col. 6, line 1; Fig. 1, elements 34 and 36a-36i; col. 9, lines 3-9). *It should be noted that the "write watch module" is analogous to the "tracking mechanism", the "array of memory locations" is analogous to the "list", each set of "memory objects" (i.e. 36a-36i) is analogous to a "card", and the "bit map" is analogous to the "card table."*

and performing garbage collection upon the at least one accessed object (col. 11, lines 42-53; Fig. 4, element 318).

Dussud does not disclose creating, during the ephemeral garbage collection process, a bundle table containing entries identifying a plurality of bundles, wherein each of the plurality of bundles identifies groupings of subsets of the plurality of cards;

marking, during the ephemeral garbage collection process, two or more of the plurality of bundles identified in the bundle table using the list, wherein the marked bundles identify groupings of subsets of the plurality of marked cards having associated objects that have been accessed since a last garbage collection process;

for each marked bundle identified in the bundle table, determining at least one marked card in a grouping of subsets of the plurality of marked cards identified by the marked bundle;

for each determined marked card, determining at least one accessed object within associated with the marked card;

AAPA discloses creating, during the ephemeral garbage collection process, a bundle table containing entries identifying a plurality of bundles, wherein each of the plurality of bundles identifies groupings of subsets of the plurality of cards (paragraph 0007); *It should be noted that the "bundle bit map" is analogous to the "bundle table."*

wherein the marked bundles identify groupings of subsets of the plurality of marked cards having associated objects that have been accessed since a last garbage collection process (paragraph 0007); *It should be noted that a "card" which has been "accessed" is analogous to a "marked card."*

for each marked bundle identified in the bundle table, determining at least one marked card in a grouping of subsets of the plurality of marked cards identified by the marked bundle (paragraph 0007);

for each determined marked card, determining at least one accessed object within associated with the marked card (paragraph 0007);

Dussud and AAPA are analogous art because they are from the same field of endeavor, that being garbage collection systems.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to apply AAPA's card table/bundle garbage collection process, a know

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technique, to Dussud's concurrent garbage collection, a known system ready for improvement, such that the combined garbage collection system would, mark, during the ephemeral garbage collection process, two or more of the plurality of bundles identified in the bundle table of AAPA using Dussud's list, so as to yield the predictable results of improving the efficiency of ephemeral garbage collection as well helping minimize the dependency of ephemeral garbage collection on heap size.

4. **As per claim 2**, the combination of Dussud/AAPA discloses the tracking mechanism comprises a write-watch mechanism, identifying cards having objects that have been accessed since the last ephemeral garbage collection process (Dussud, col. 5, lines 42-45 and 50-51; col. 6, lines 34-44; Fig. 1, element 32).

5. **As per claim 3**, the combination of Dussud/AAPA discloses the write-watch mechanism operates within a memory manager (Dussud, col. 5, lines 35-36; Fig. 1, elements 28 and 32).

6. **As per claim 4**, the combination of Dussud/AAPA discloses the write-watch mechanism records a first access to a one of the plurality of memory locations (Dussud, col. 5, lines 42-45).

7. **As per claim 5**, the combination of Dussud/AAPA discloses the list comprises a bitmap and each bit within the bitmap corresponds to one of the plurality of cards (Dussud, col. 9, lines 3-9).

8. **As per claim 6**, the combination of Dussud/AAPA discloses the write-watch mechanism maintains the list of memory locations in response to a request from the ephemeral garbage collection process (Dussud, col. 5, lines 50-51; Fig. 1, elements 30

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and 32). *It should be noted that the “garbage collector” is analogous to the “garbage collection process.”*

9. **As per claim 7**, the combination of Dussud/AAPA discloses resetting the list of memory locations (Dussud, col. 5, lines 52-55).

10. **As per claim 8**, the combination of Dussud/AAPA discloses the subset of cards corresponds to a number of cards that are tracked using a page of memory storing the card table (Dussud, col. 5, lines 64-67; Fig. 1, element 34). *It should be noted that “memory portion” is analogous to the “memory storing the card table.”*

11. **As per claim 9**, the combination of Dussud/AAPA discloses identifying the marked bundle comprises marking a bit associated with the marked bundle table within a bundle bitmap based on the memory locations within the list (AAPA, paragraph 0007; Dussud, col. 5, lines 42-45 and 50-51).

12. **As per claim 10**, the combination of Dussud/AAPA discloses marking the bit comprises setting the bit (AAPA, paragraph 0007).

13. **As per claim 11**, the combination of Dussud/AAPA discloses determining the at least one marked card comprises scanning a card bitmap having a bit for each of the plurality of cards, the bit for each marked card being different than another bit of the card bitmap associated with one of the cards that was not accessed (Dussud, col. 9, lines 3-9; AAPA, paragraph 0007).

14. **As per claim 12**, Dussud discloses a method for executing statements within a program to support ephemeral garbage collection (col. 8, lines 46-53; Fig. 3), the method comprising:

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specifying a range of card table memory to watch during program execution by calling a write-watch mechanism that performs tracking of the accesses to card table memory and maintains a write-watch list that identifies cards accessed within the card table memory since a garbage collection process was last performed (col. 8, line 65 – col. 9, line 11; Fig. 2, element 204; col. 5, lines 42-50), each card being associated with and update upon access to one or more objects allocated within the memory heap, the memory heap being divided into the plurality of cards, a subset of that plurality of cards that are tracked using a page of card table memory that are tracked using a page of card table memory (col. 5, line 64 – col. 6, line 1; Fig. 1, elements 34 and 36a-36i); *It should be noted that the “memory portion” is analogous to the “card table memory.”*

storing a value within the memory heap at a memory location specified by a storing statement, marking one of the plurality of cards within the card table memory corresponding to the memory location (col. 9, lines 3-9; Fig. 3, element 204);

tracking access to the card table memory by the write-match mechanism (col. 8, line 65 – col. 9, line 11; Fig. 3, element 204; col. 5, lines 42-45 50-51; Fig. 1, element 32);

performing garbage collection during the ephemeral garbage collection process upon the at least one accessed object (col. 11, lines 42-53; Fig. 4, element 318).

Dussud does not disclose each card being grouped into one of a plurality of bundles, wherein each of the plurality of bundles corresponds to a subset of that plurality of cards;

creating one or more bundle tables containing entries identifying groupings of the cards in the plurality of bundles for each stored statement within the program;

updating, during the ephemeral garbage collection process, at least one bundle table by marking the entries in the bundle table based on information obtained from the write-watch list, wherein the updated marked bundle table identifies groupings the plurality of marked cards having associated objects that have been accessed since a last garbage collection process;

for each marked bundle table, determining during the ephemeral garbage collection process at least one marked card in a grouping of the plurality of marked cards identified by the marked bundle table;

for each marked card, determining during the ephemeral garbage collection process at least one accessed object associated with the marked card.

AAPA discloses each card being grouped into one of a plurality of bundles, wherein each of the plurality of bundles corresponds to a subset of that plurality of cards (paragraph 0007);

creating, during an ephemeral garbage collection process, one or more bundle tables containing entries identifying groupings of the cards in the plurality of bundles, for each stored statement within the program, the ephemeral garbage collection process occurring after the program execution process (paragraph 0007);

wherein the updated marked bundle table identifies groupings the plurality of marked cards having associated objects that have been accessed since a last garbage collection process (paragraph 0007);

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for each marked bundle table, determining during the ephemeral garbage collection process at least one marked card in a grouping of the plurality of marked cards identified by the marked bundle table (paragraph 0007);

for each marked card, determining during the ephemeral garbage collection process at least one accessed object associated with the marked card (paragraph 0007).

Dussud and AAPA are analogous art because they are from the same field of endeavor, that being garbage collection systems.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to apply AAPA's card table/bundle garbage collection process, a known technique, to Dussud's concurrent garbage collection, a known system ready for improvement, such that the combined garbage collection system would update, during the ephemeral garbage collection process, at least one bundle table by marking the entries in the bundle table based on information obtained from the write-watch list, so as to yield the predictable results of improving the efficiency of ephemeral garbage collection as well helping minimize the dependency of ephemeral garbage collection on heap size.

15. **As per claim 14**, the combination of Dussud/AAPA discloses the tracking includes the write-watch mechanism residing within a memory manager and setting bits in the card table upon access to at least one of the plurality of cards (Dussud, col. 5, lines 35-36; col. 9, lines 1-9; Fig. 1, elements 28 and 32).

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16. **As per claim 17**, the combination of Dussud/AAPA discloses the ephemeral garbage collection process requests the list when performing a garbage collection cycle (Dussud, col. 5, lines 50-51; Fig. 1, element 30).

17. **As per claim 18**, the combination of Dussud/AAPA discloses the ephemeral garbage collection process determines a marked bundle based on the write-watch list (AAPA, paragraph 0007; Dussud, col. 5, lines 42-45). *See the rejection of claim 12 above. It should be noted that when combining Dussud and AAPA as set forth in the rejection of claim 12 above, any markings to AAPA's bundle table would be based on Dussud's array of memory locations.*

18. **As per claim 19**, Dussud discloses a memory management system, the system comprising:

a processor (col. 7, line 1; Fig. 2, element 104);

and a memory into which a plurality of instructions are loaded (col. 7, lines 35-39; Fig. 2, element 106) and into which a plurality of objects are dynamically allocated, the memory having a heap into which the objects are allocated, the heap being divided into a plurality of cards, each card being associated with one or more of the plurality of objects (col. 5, line 64 – col. 6, line 1; Fig. 1, elements 34 and 36a-36i);

wherein upon execution of the plurality of instructions by the processor, the system being configured to:

request a list from a tracking mechanism (col. 5, lines 50-51; Fig. 1, element 32), the list identifying memory locations that have been written into since a last garbage collection cycle (col. 5, lines 42-45; col. 6, lines 34-44), each memory location

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corresponding to one of the plurality of cards associated with a card table, wherein the card table identifies one or more cards that have been accessed(col. 9, lines 3-9), the card table and cards being marked to identify the one or more of the plurality of cards with the one or more objects that have been accessed, during a first program execution process exclusive of an ephemeral garbage collection process (col. 8, line 65 – col. 9, line 11; Fig. 2, element 204; col. 5, lines 42-50);

and perform, during the ephemeral garbage collection process, garbage collection upon the one or more accessed objects (col. 11, lines 42-53; Fig. 4, element 318).

Dussud does not disclose creating, during the ephemeral garbage collection process, one or more bundle tables wherein each bundle table identifies groupings of the plurality of cards in the plurality of bundles;

updating, during the ephemeral garbage collection process, at least one bundle table by marking bundles within the bundle table based on the list, wherein the marked bundles corresponds to marked cards having associated objects that have been accessed since a last garbage collection process;

determine, during the ephemeral garbage collection process, for each marked bundle within the bundle table, at least one marked card within the marked bundle, the at least one marked card indicating that one or more objects associated with the marked card have been accessed;

determine, during the ephemeral garbage collection process, for each marked card, the one or more objects that have been accessed.

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AAPA discloses creating, during the ephemeral garbage collection process, one or more bundle tables wherein each bundle table identifies groupings of the plurality of cards in the plurality of bundles (paragraph 0007);

wherein the marked bundles corresponds to marked cards having associated objects that have been accessed since a last garbage collection process (paragraph 0007);

determine, for each marked bundle within the bundle table, at least one marked card within the marked bundle, the at least one marked card indicating that one or more objects associated with the marked card have been accessed (paragraph 0007);

determine, for each marked card, the one or more objects that have been accessed (paragraph 0007).

Dussud and AAPA are analogous art because they are from the same field of endeavor, that being garbage collection systems.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to apply AAPA's card table/bundle garbage collection process, a known technique, to Dussud's concurrent garbage collection, a known system ready for improvement, such that the combined garbage collection system would update, during the ephemeral garbage collection process, at least one bundle table by marking bundles within the bundle table based on the list, so as to yield the predictable results of improving the efficiency of ephemeral garbage collection as well helping minimize the dependency of ephemeral garbage collection on heap size.

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19. **As per claim 20**, the combination of Dussud/AAPA discloses the tracking mechanism comprises a write-watch mechanism (Dussud, col. 5, lines 50-51; Fig. 1, element 32).

20. **As per claim 21**, the combination of Dussud/AAPA discloses the write-watch mechanism resides within a memory manager and sets bits in the card table upon access to at least one of the plurality of cards (Dussud, col. 5, lines 35-36; col. 9, lines 1-9; Fig. 1, elements 28 and 32).

21. **As per claim 22**, the combination of Dussud/AAPA discloses the subset of cards corresponds to a number of cards that are tracked using a page of memory storing the card table (Dussud, col. 5, lines 64-67; Fig. 1, element 34).

22. **As per claim 23**, the combination of Dussud/AAPA discloses the marked bundle being identified by a marked bit associated with the marked bundle within a bundle bitmap based on the list (AAPA, paragraph 0007; Dussud, col. 5, lines 42-45). *See the rejection of claim 19 above. It should be noted that when combining Dussud and AAPA as set forth in the rejection of claim 19 above, any markings to AAPA's bundle table would be based on Dussud's array of memory locations.*

23. **As per claim 24**, the combination of Dussud/AAPA discloses setting a bit in the card table to identify one or more cards that have been accessed (Dussud, col. 9, lines 7-9).

Response to Arguments

24. Applicant's arguments filed June 8, 2009 with respect to **claims 1-12, 14, and 17-24** have been fully considered but they are not persuasive.

25. With respect to Applicant's arguments regarding independent claims 1, 12, and 19, which substantially argue that neither Dussud or AAPA disclose the steps of creating, marking, updating, determining, or performing "during the ephemeral garbage collection process", the Examiner respectfully disagrees. When taking the broadest reasonable interpretation of the term "garbage collection process" it follows that all the steps performed prior the actual garbage collection step are still part of the garbage collection "process" as a whole and therefore these steps occur during the "garbage collection process". Therefore, when taking into account what the ephemeral garbage collection "process" actually entails, the steps performed in Figs. 3 and 4 of Dussud occur during the "ephemeral garbage collection process" and the steps performed in paragraph 0007 of AAPA occur during the "ephemeral garbage collection process". Accordingly, the combination of Dussud/AAPA sufficiently discloses the steps of creating, marking, updating, determining, and performing during the ephemeral garbage collection process, as simply and broadly claimed by Applicant.

26. As for Applicant's arguments with respect to the dependent claims, the arguments rely on the allegation that the independent claims are patentable and therefore for the same reasons the dependent claims are patentable. However, as addressed above, the independent claims are not patentable, thus, Applicant's arguments with respect to the dependent claims are not persuasive.

Conclusion

STATUS OF CLAIMS IN THE APPLICATION

The following is a summary of the treatment and status of all claims in the application as recommended by MPEP 707.70(i):

CLAIMS REJECTED IN THE APPLICATION

Per the instant office action, **claims 1-12, 14, and 17-24** have received an action on the merits and are subject of a final action.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Arpan P. Savla whose telephone number is (571) 272-1077. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sanjiv Shah can be reached on (571) 272-4098. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Arpan Savla/
Examiner, Art Unit 2185
August 6, 2009

/Sanjiv Shah/
Supervisory Patent Examiner, Art
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